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Federal and State Efforts to Control Water Pollution Caused by Acid Drainage from Mines

Comptroller General of the United States

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This report has been requested because of congressional interest in programs to control water pollution caused by acid drainage from mines. Representatives of the General Accounting Office (GAO) visited Illinois, Kentucky, Maryland, Ohio, Pennsylvania, and West Virginia to identify their efforts in controlling water pollution caused by acid drainage.

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-177011

The Honorable Henry S. Reuss, Chairman
Subcommittee on Conservation and
Natural Resources
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

Pursuant to your request of August 21, 1972, this is our report on "Federal and State Efforts to Control Water Pollution Caused by Acid Drainage From Mines."

A limited number of copies contain color photographs illustrating some of the conditions described in this report.

As your office requested, we did not obtain written agency comments on a draft of this report. However, we discussed the matters in the report with officials of the Environmental Protection Agency and considered their views in finalizing the report.

We do not plan to distribute this report further unless you agree or publicly announce its contents.

Sincerely yours,

Comptroller General
of the United States

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ABBREVIATIONS

EPA	Environmental Protection Agency
GAO	General Accounting Office
TVA	Tennessee Valley Authority

Glossary

Acid drainage	Water pollution formed by a chemical reaction when mining operations expose sulfur-bearing materials to air and water
Alkaline material	Material, such as lime or limestone, capable of neutralizing acids.
Hydrology	The science of water--its properties, laws, and distribution, including underground sources.
Neutralization	A treatment method which chemically counteracts the polluting effects of acid drainage by exposing the acid to an alkaline material.
Refuse piles	Accumulations of soil, rock, and impurities which remain after coal has been cleaned and processed.
Sludge	A residue from treatment of acid drainage.
Slurry areas	Holding areas containing waste water used to clean and process a mineral.
Spoil	The overburden of rock and soil which is removed to reach a coal seam during surface or underground mining operations.

COMPTROLLER GENERAL'S REPORT TO THE SUBCOMMITTEE ON CONSERVATION AND NATURAL RESOURCES, COMMITTEE ON GOVERNMENT OPERATIONS HOUSE OF REPRESENTATIVES

FEDERAL AND STATE EFFORTS TO CONTROL WATER POLLUTION CAUSED BY ACID DRAINAGE FROM MINES
B-177011

D I G E S T

WHY THE REVIEW WAS MADE

The Chairman of the Subcommittee requested this report because he was interested in programs to control water pollution caused by acid drainage from mines.

Federal agencies having such programs include the

--Environmental Protection Agency (EPA),

--Department of the Interior,

--Department of Agriculture,

--Tennessee Valley Authority,

--Corps of Engineers, and

--Appalachian Regional Commission.

GAO visited Illinois, Kentucky, Maryland, Ohio, Pennsylvania, and West Virginia to identify their efforts in controlling water pollution caused by acid drainage.

As requested by the Chairman, GAO did not obtain written comments from EPA on this report. However, GAO discussed matters contained in the report with EPA officials and considered their views.

FINDINGS AND CONCLUSIONS

Acid is formed by a chemical reaction in or around a mine when sulfur-bearing minerals are exposed to air and water. The air and water react with these minerals in mined areas or mine refuse piles to form sulfuric acid and iron compounds, which are then transported by the flow of water into streams, rivers, ponds, and lakes.

Federal efforts to control acid drainage from mines consisted primarily of conducting research, development, and demonstration projects to find new processes to control this form of water pollution.

Research, development, and demonstration projects

During fiscal years 1967 through 1972, 101 federally assisted projects totaling about $15.8 million were conducted. EPA funded 76 of these projects for which the Federal share was about $11.5 million.

The Departments of Agriculture and the Interior, the Corps of Engineers, and the Appalachian Regional Commission funded the other 25 projects for which the Federal share was about $4.3 million.

Pennsylvania was the only State included in GAO's review which supported a research and development program directly related to controlling acid drainage. Funds for this program were $5.6 million, of which $3.1 million was provided by EPA.

Tear Sheet. Upon removal, the report cover date should be noted hereon.

EPA's progress to solve the acid drainage problem has been slow. It estimated that about 70 percent of the technology had been developed to treat acid-polluted water adequately. However, development of the technology to prevent acid from forming and draining into waterways ranges from 10-percent to 50-percent complete for underground mines and surface sources, respectively.

An EPA official stated that the necessary technology to treat and prevent acid drainage could be developed and demonstrated by 1980 if its $129 million estimate of the funding necessary to complete such technology was made available. EPA officials said, however, that, on the basis of current and anticipated funding levels, the technology to control acid drainage could not be developed and demonstrated before the early 1990s.

Funding cutbacks in the past several years significantly affected EPA's efforts to develop and demonstrate technology. EPA officials said that funds were redirected from the acid drainage program to other higher priority programs to control other forms of water pollution because more immediate results could be achieved. (See p. 13.)

EPA's acid drainage program involved basic research, technology development to treat acid-polluted water and prevent the formation and drainage of acid, and demonstrations of the technology developed.

EPA's major effort was in developing treatment technology. As of April 1973, it had conducted 33 projects totaling about $7.2 million, of which $3.6 million was from non-Federal sources.

EPA's estimate that about 70 percent of the technology has been developed to adequately treat acid drainage from mines appears reasonable.

Individual projects to treat acid drainage, if funded adequately, appear to be progressing so as to allow EPA to meet its 1978 date for developing required treatment technology. (See pp. 20 to 25.)

Implementation programs

Permit programs for active mines and action programs for abandoned mines were being used for preventing or controlling acid water pollution. The six States visited had permit programs which provided for control of water pollution from active mining operations.

The Federal Water Pollution Control Act Amendments of 1972 require all States to modify their water quality standards and permit programs as necessary to comply with certain provisions of the amendments. EPA is responsible for reviewing and approving the States' standards and permit programs. Until the programs are approved, EPA will issue discharge permits for all water pollution sources in each State.

EPA and other Federal agencies generally do not have the authority to conduct action programs to control acid drainage from abandoned mines. Under the Appalachian Regional Development Act of 1965, Interior is authorized to contribute funds to Appalachian States for projects to prevent water pollution from abandoned underground and surface mines.

An official of the Appalachian Regional Commission, the agency which must approve such projects, indicated

that as of April 1973 no such projects had been funded and that, even if additional funds were available to the Commission, it was doubtful that significant amounts would be spent on acid drainage because of higher priority needs, such as highway construction, health, education, and vocational training.

Pennsylvania and Maryland had action programs that were funded at $150 million and $5 million, respectively. These programs included identifying the sources of acid pollution, determining and implementing the control techniques most applicable in each case, and monitoring the results.

The six States told GAO that the Federal Government should appropriate funds to support action programs because of the high costs. (See p. 15.)

Conclusion

The Federal Water Pollution Control Act Amendments of 1972 established, as a national goal, the elimination of the discharge of pollutants into navigable waters by 1985. The act stated that it was the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate such discharges.

Interior's 1969 annual report on the cost to clean up water pollution stated that it would cost about $6.6 billion to reduce acid drainage from mines by 95 percent. These costs were based on a nationwide, 20-year program to prevent or control pollution from active and abandoned mines.

Until significantly more Federal and State funds are made available for the development of additional technology and for an action program to systematically identify and control acid drainage from abandoned mines, only limited progress can be made toward reducing pollution caused by discharges of acid into the Nation's streams, rivers, lakes, and ponds.

CHAPTER 1

INTRODUCTION AND SCOPE OF REVIEW

The Chairman of the Subcommittee on Conservation and Natural Resources, House Committee on Government Operations, in a letter dated August 21, 1972 (see app. I), requested us to review the administration of Federal agency programs to control acid and other mine water pollution. Subsequently, our representatives were informed that the Chairman was particularly interested in programs to control water pollution caused by acid drainage from mines.

FORMATION OF ACID DRAINAGE

Ground or surface water draining into streams and ponds from mines or mining sites usually contains acid, iron, sulfate, aluminum, manganese, and sediment which, in significant concentrations, pollute our waterways. These pollutants occur naturally as a result of normal hydrologic and weathering cycles, but mining operations increase them substantially.

Acid causes more damage than any of the other pollutants originating from mines. Acid is formed by a chemical reaction in or around the mine when sulfur-bearing minerals are exposed to air and water. The air and water react with these minerals in mined areas or mine refuse piles to form sulfuric acid and iron compounds which are then transported by the flow of water from mines into streams, rivers, ponds, and lakes. This chemical reaction often continues indefinitely after mining operations have stopped and, unless controlled, can be a major source of water pollution for years.

Mining most types of ores causes acid drainage, but coal mines cause the most water pollution. In 1967 Interior reported that 97 percent of all acid pollution in streams and about 93 percent in ponds resulted from coal mining.

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FEDERAL AND STATE FUNDING

During fiscal years 1967-72, the Environmental Protection Agency (EPA)[1]; the Departments of the Interior and Agriculture; the Corps of Engineers; and the Appalachian Regional Commission funded 101 projects totaling about $15.8 million--$11.5 million funded by EPA--relating directly to water pollution caused by acid drainage.

We visited Illinois, Kentucky, Maryland, Ohio, Pennsylvania, and West Virginia--States with heavy mining activity--to identify their efforts in controlling acid mine drainage. Pennsylvania has conducted a $5.6 million research and development program and has a $150 million action program to prevent and control water pollution from abandoned mines. Although Maryland has a similar action program with funds of about $5 million, it has no research and development program. The other four States have no research and development or action programs.

SCOPE OF REVIEW

Pursuant to the Chairman's request and subsequent discussions with his office, we (1) ascertained the magnitude of the water pollution problem caused by drainage of acidic water from mines, (2) determined Federal and State agency efforts to control such water pollution, (3) obtained data on EPA's program to develop and demonstrate acid drainage control technology, (4) reviewed certain aspects of EPA's administration of that program, and (5) inquired as to whether Federal agencies were coordinating their efforts.

We also reviewed provisions in the coal purchase contracts of the Tennessee Valley Authority (TVA) and coal mining leases of the Department of the Interior to determine whether they contained clauses insuring the implementation of technology to control acid drainage from mining operations.

We conducted our review from September 1972 through April 1973 at EPA's National Environmental Research Center,

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[1]See app. IV for a chronology of EPA and its predecessor agencies which had responsibility for administering the Federal mine drainage pollution control program.

Cincinnati, Ohio; the Federal agency and Appalachian Regional Commission offices in Washington, D.C.; and the agencies responsible for controlling acid drainage from mines in the six States.

Because the research activities were technical, we engaged a consultant to help us evaluate the effectiveness of certain aspects of EPA's research program.

CHAPTER 2

EFFORTS TO CONTROL WATER POLLUTION CAUSED BY ACID DRAINAGE FROM MINES

Acid drainage from mines into waterways has been called the colorful killer because of its bright orange hue in water; its bright yellow or reddish-brown deposits along the beds and banks of streams, rivers, ponds, and lakes; and its destruction of aquatic plant and animal life.

[Photograph not included in this copy of the report.]

(EPA Photograph)

ACID DRAINAGE FROM AN ABANDONED MINE

[Photograph not included in this copy of the report.]

(EPA Photograph)

ACID-POLLUTED STREAM FLOWING INTO A RIVER

When present in sufficient concentrations, acid in water kills fish, fish food organisms, and aquatic plant life; lessens the water's recreational and aesthetic values; corrodes equipment exposed to the water; and requires expensive treatment when such water is used by municipalities and industries.

Although mining operations are conducted throughout the United States, approximately 75 percent of the acid drainage has occurred from Appalachian coal mines. In a 1969 report on acid drainage from these mines, the Appalachian Regional Commission stated that, of the 10,500 miles of Appalachian streams affected, 5,700 miles were continually polluted by acid drainage. Three-fourths of these stream-miles were in Pennsylvania, West Virginia, and Maryland.

Acid drainage comes from both active, abandoned, or inactive mines. The 1969 Commission report stated that almost 80 percent of the acid drainage in Appalachia comes from abandoned mines.

Interior's 1969 annual report on the cost to clean up water pollution stated that it would cost about $6.6 billion to reduce acid drainage from mines by 95 percent. These costs were based on a nationwide, 20-year program to clean up pollution from active and abandoned mines.

FEDERAL AND STATE PROGRAMS FOR CONTROLLING ACID DRAINAGE

Federal and State agencies could use a three-phased approach to control acid drainage:

--Research programs to develop the technology to solve the problem.

--Demonstration programs to determine the feasibility of implementing the technology developed.

--Implementation programs to apply the technology determined feasible.

Research, development, and demonstration

EPA has conducted the major program to develop and demonstrate technology to control acid drainage, although other Federal agencies and Pennsylvania have had programs.

Four Federal agencies and 1 Federal-State commission funded 101 research, development, and demonstration projects during fiscal years 1967 through 1972. These projects were carried out through contracts, grants, and in-house efforts.

Projects Related to Prevention, Abatement, and Control of Acid Drainage from Mines
Fiscal Years 1967-72

Agency	Projects			Federal funding
	Active	Completed	Total	
EPA	24	52	76	$11,500,000
Department of the Interior	3	8	11	960,000
Department of Agriculture	4	-	4	1,980,000
Corps of Engineers	2	1	3	470,000
Appalachian Regional Commission	4	3	7	890,000
	37	64	[a]101	$15,800,000

[a]See apps. II and III for a brief description of these projects.

Pennsylvania has also conducted a $5.6 million technology development program, about $3.1 million of which was provided by EPA.

EPA officials told us that no single process or method had been developed which could control water pollution from acid drainage. They said that (1) the formation and characteristics of acid drainage vary, depending on such factors as topography, type of mine, average rainfall, amount of ground water, and activity at the mine and (2) a combination of several control techniques must often be used within a single mine.

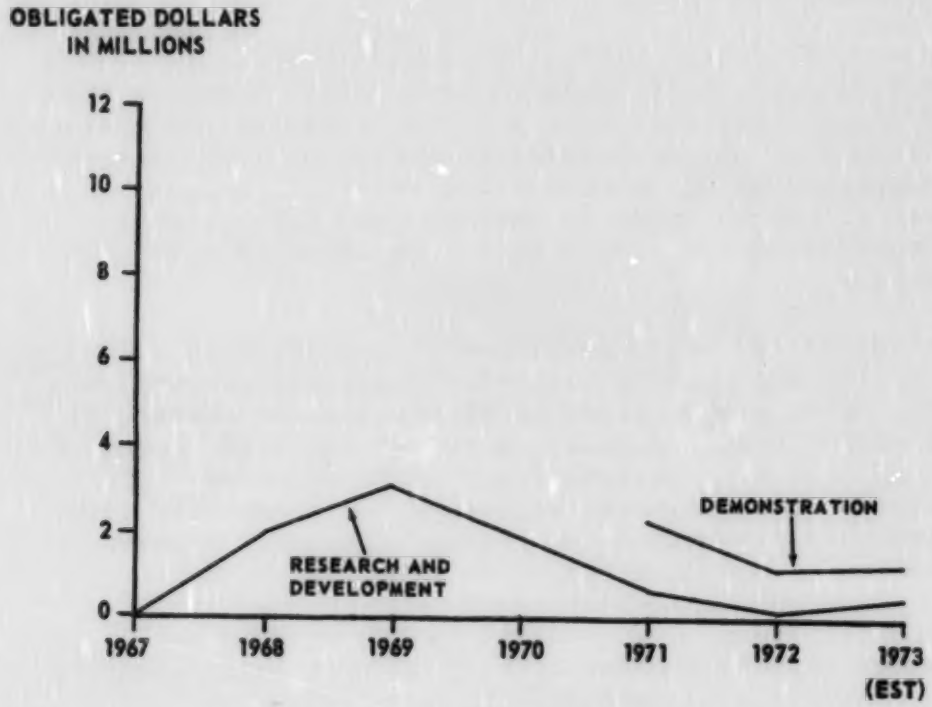
The technology being developed to control acid drainage falls into two major categories--treatment and prevention. Treatment, using either chemical or physical processes, is the most widely used. However, a report entitled "Legal Problems of Coal Mine Reclamation," prepared under an EPA grant, states that treatment processes are inherently less attractive than prevention techniques since they require costly operation and maintenance to remain effective.

Prevention techniques usually center on eliminating from mines either oxygen or water or both so that sulfur-bearing minerals cannot mix to form acid.

EPA program

During fiscal years 1967 through 1972, EPA funded 66 research and development projects at a cost of about $7.9 million and 10 related demonstration projects at a cost of about $3.6 million, as shown in the following chart. The 76 projects are discussed in chapter 3.

FUNDING LEVELS OF EPA PROJECTS TO CONTROL ACID DRAINAGE FROM MINES



Progress in solving the problem of acid drainage from mines--especially from abandoned underground mines--has been slow. (See table below.)

EPA Estimate of Acid Drainage Control Technology Developed and Demonstrated as of April 1973

	Percent completed	Additional costs to complete (millions)
Research and development:		
Basic research	90	$ 0.3 to $ 0.4
Treatment	70	2.0 to 3.0
Prevention--underground mines	10	20.0 to 30.0
Prevention--surface sources	50	4.0 to 6.0
Prevention--new mining methods	[a]10	36.0 to 50.0
Demonstration	(b)	29.0 to 40.0
		$91.3 $129.4

[a]Based on techniques presently known.

[b]Projects are in their initial stages.

As the table indicates, EPA estimated that 70 percent of the technology needed to treat acid drainage has been developed, and that between 10 and 50 percent of the technology needed to prevent acid drainage has been developed.

An EPA official told us that the necessary technology to treat and prevent acid drainage could be developed and demonstrated by 1980 if funds for the total estimated maximum cost of $129 million were made available during the intervening years so that optimum funding levels of approximately $30 million a year could be reached during 1977 and 1978.

EPA's acid drainage program has, however, had funding cutbacks in the past several years which have adversely affected EPA's efforts to develop and demonstrate technology. For example, EPA personnel responsible for the mine drainage program stated that promising acid drainage technology development projects have been delayed as much as 2 years because of limited funding. During fiscal year 1972, EPA also reduced the funds allocated to the acid drainage demonstration program from $2.2 million to $1.2 million.

The funding cutbacks resulted from EPA officials' redirecting funds from the acid drainage program to other programs which they considered of higher priority. Because these officials considered the acid drainage problem one of the most technically difficult to solve, they concentrated on other forms of water pollution for which more immediate results could be achieved.

EPA projections for fiscal year 1974 and beyond indicate that funding for the acid drainage program will increase at an annual rate of from 5 to 20 percent. On the basis of these projections, EPA estimated that technology cannot be developed and demonstrated to adequately control acid drainage before the early 1990s.

EPA plans to concentrate its efforts primarily on demonstration projects and to direct research and development efforts toward prevention, rather than treatment, technology.

Other Federal and State programs

Interior and Agriculture, the Corps of Engineers, the Appalachian Regional Commission, and Pennsylvania have conducted some research, development, and demonstration projects related to controlling acid drainage. The Federal and Commission projects, discussed in chapter 4, were conducted as part of those agencies' missions and not as part of an overall coordinated effort to control acid drainage. An EPA official informed us that his agency was generally aware of the projects and that several had benefited EPA's program.

Pennsylvania was the only State in our review which had funded a technological development program directly related to controlling acid drainage. Although the programs of the Federal agencies and of Pennsylvania have contributed, EPA's program is the major effort directed to developing the technology necessary to control water pollution caused by acid drainage. Federal and State officials told us that a continuing Federal effort to develop and demonstrate technology is needed.

Implementation

Permit programs for active mines and action programs to control drainage from abandoned mines were being used for preventing or controlling acid water pollution.

The six States in our review had permit programs. These programs generally regulate the quality of mine water drainage--including discharge of water from mines, erosion, and disposal of waste material during active mining operations--and require acid-producing materials to be buried and mine shafts and tunnels to be closed or sealed when mining operations are completed. If a permit holder fails to comply with the requirements, the permit becomes the basis for assessment of penalties, legal action to force compliance, or both. We did not review the effectiveness of the State permit programs.

All States are required to modify their water quality standards and permit programs to comply with the requirements of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). EPA is responsible for reviewing and approving State standards and permit programs. Until

they are approved, EPA will issue permits to dischargers of pollutants in each State. The States will retain the primary responsibility for enforcing these permits; however, if a State fails to act within 30 days after receiving EPA's notice of violation, EPA is empowered to proceed against a permit holder violating water quality standards.

An EPA official informed us that the 1972 amendments were silent on controlling water pollution from abandoned mines. Enforcement action against owners of abandoned mines is complicated because (1) the owners of land having abandoned mines often did not own the land when the mines were operating and (2) at the time the mines were operating no requirements existed to control acid drainage. Federal and State officials told us that the control of discharges from abandoned mines depends on the expenditure of public money to conduct full-scale action programs to prevent and control acid drainage.

Pennsylvania and Maryland are conducting such programs and have funding levels of $150 million and $5 million, respectively. These programs include identifying the sources of acid pollution, determining and implementing the control techniques most applicable in each case, and monitoring the results. The six States told us that the Federal Government should appropriate funds to support action programs because of the high costs.

EPA officials stated that they did not have authority to financially aid the States in controlling discharges from abandoned mines. We identified only one source--Interior--of Federal funds for an action program to abate acid drainage from abandoned mines.

Under section 205 of the Appalachian Regional Development Act of 1965, as amended, Interior is authorized to contribute funds to Appalachian States' projects to prevent water pollution from abandoned underground and surface mines. Such projects must be approved by the Appalachian Regional Commission. A Commission official told us that, although the act authorized action projects, no project to control acid mine drainage had been funded as of April 1973. He said that, even if additional funds were available, it was doubtful that the Commission would spend significant amounts on acid drainage control because the Appalachian States had higher priority needs for highway construction, health, education, and vocational training programs.

ACID DRAINAGE CONTROL PROVISIONS IN FEDERAL CONTRACTS AND LEASES

TVA is the Nation's largest electric power producer and coal consumer. In 1970 TVA purchased more than 33.6 million tons of coal for generating power; approximately 53 percent of it came from surface mines. In 1965 TVA began to require reclamation and conservation plans in its purchase contracts for strip-mined coal. Bids submitted to TVA must also include such plans. The plans must provide that, among other things, the operators properly handle and segregate acid-forming materials within the mining pit; cover exposed areas of coal, the bottom of the pit, and all acid-forming materials to a depth of at least 4 feet; and control water flow from the mine area to minimize soil erosion, damage to other lands, and pollution of streams or other waters. The plans become part of the contracts if they meet TVA's approval, and the contractors are required to perform their mining operations accordingly. The contracts, however, have not specifically provided that the best available technology be used to treat acid drainage.

We did not evaluate the administration or effectiveness of TVA's reclamation and conservation requirements. However, in our August 9, 1972, report[1] to Congressman Ken Hechler on the administration of land reclamation requirements of TVA coal purchase contracts, we stated that (1) TVA did not have adequate procedures for conducting and reporting on inspections of reclamation activities, (2) the frequency of inspections of mining sites varied significantly, and (3) the inspection reports did not always show whether the reclamation requirements were being met.

On September 12, 1972, in response to this report, the Chairman of TVA stated that under TVA's new requirements, areas and seams known to have a high acid overburden are carefully evaluated and if those evaluations indicate a potential inability of the producer to properly handle such material, TVA's contract with the producer may contain a provision prohibiting mining in such areas.

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[1]"Opportunities for Improvement in Reclaiming Strip-Mined Lands Under Coal Purchase Contracts" (B-114850).

The Chairman stated that TVA had revised its inspection reporting requirements and that, at that time, inspection report forms were being revised to more clearly document inspection findings. He stated also that the inspection staff had been increased to insure that critical mines would be inspected no less than twice a month, with many being inspected weekly.

In January 1972 Interior estimated that 41 million of the 825 million acres of public land and 13.5 million of the 50 million acres of Indian land it administered had coal deposits. At that time, 1.6 million acres of the public land and 700,000 acres of the Indian land were subject to coal-prospecting permits or coal-mining leases, which are administered by Interior's Bureaus of Land Management and Indian Affairs, respectively. Interior's Geological Survey is responsible for providing scientific and technical advice to both Bureaus.

Permits and leases did not specifically provide that the best available technology be used to treat acid drainage. Interior, however, had regulations which provided for the protection of the environment during mining operations. The regulations required the Bureaus, in reviewing an application for a permit or a lease, to conduct a technical examination of the environmental effects of the proposed exploration or surface-mining operations.

The regulations also required that, before an operator began any surface operations to explore or mine for coal on public or Indian land, an exploration and mining plan be filed by the operator and approved by the Geological Survey.

The Survey may require such a plan to include a description of measures to be taken to prevent and control soil erosion, water pollution, and damage to fish and wildlife or other natural resources. A mining plan may also be required to include (1) an estimate of pollutants expected to enter waters, (2) a design for impoundment, treatment, or control of runoff water and drainage from works, and (3) a statement of the proposed manner and time of reclaiming disturbed areas.

We did not evaluate the administration or effectiveness of these regulations; however, in our August 10, 1972, report[1] to the Chairman, Subcommittee on Conservation and Natural Resources, we concluded that Interior's regulations, if properly implemented, should help to protect environmental values. We reported that, of the 65 permits and leases reviewed, 35 had not had the required technical examinations. The report stated that as of June 30, 1972, the Bureau of Land Management had instructed its field offices to implement the regulations but that the Geological Survey and the Bureau of Indian Affairs had not. Department officials stated that both the Geological Survey and the Bureau of Indian Affairs planned to issue instructions; however, as of April 1973, they had not done so.

PROGRAMS NEEDED TO CONTROL ACID DRAINAGE FROM MINES

The Federal Water Pollution Control Act Amendments of 1972 established, as a national goal, the elimination of the discharge of pollutants into navigable waters by 1985. The act stated that national policy required a major research and demonstration effort to be made to develop technology necessary to eliminate such discharges.

An EPA official stated that such a goal was attainable with anticipated technology for active mining operations through a water pollution discharge permit program and effective enforcement actions. The official stated, however, that achievement of this goal for abandoned mines would require a major effort to develop additional technology and a significant Federal and State action program to implement it.

Until significantly more Federal and State funds are made available for the development of additional technology and for an action program to systematically identify and clean up acid drainage from abandoned mines, we believe that only limited progress can be made toward reducing pollution caused by discharges of acid into the Nation's streams, rivers, lakes, and ponds.

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[1] "Administration of Regulations for Surface Exploration, Mining, and Reclamation of Public and Indian Coal Lands" (B-148623).

CHAPTER 3

RESULTS OF EPA PROJECTS

EPA's research program objectives for controlling or preventing water pollution caused by acid drainage from mines are to:

--Develop technology to control and abate water pollution caused by mine drainage.

--Demonstrate to potential users--States and industries--the feasibility and practicality of the technology developed.

--Support its regulatory mission by demonstrating acceptable techniques on which to base water discharge permits for active mines.

EPA's acid drainage research, development, and demonstration program is the responsibility of the Office of Research and Development. As of April 1973 the program was administered by a staff of 10--3 at EPA headquarters and 7 at 2 field locations.

During fiscal years 1967 through 1972, EPA funded 76 extramural acid drainage projects at a cost of about $11.5 million. Non-Federal funds totaled about $7.2 million. (See table below.) These projects were conducted by universities, States, or private firms under 49 grant and 27 contract agreements. During this time EPA also conducted an in-house research and development effort, totaling about $1.1 million, directed primarily toward developing acid drainage treatment processes.

Area	Extramural projects	Costs		
		Federal	Non-Federal	Total
Research and Development:				
Basic research	9	$ 588,000	$ 34,000	$ 622,000
Treatment	33	3,548,000	3,603,000	7,151,000
Prevention--underground mines	13	1,838,000	542,000	2,380,000
Prevention--surface sources	8	1,166,000	988,000	2,154,000
Prevention--new mining methods	3	740,000	280,000	1,020,000
Demonstration	10	3,618,000	1,755,000	5,373,000
Total	76	$11,498,000	$7,202,000	$18,700,000

As of April 1973, 52 of these projects, representing 68 percent of the total extramural projects, had been completed.

BASIC RESEARCH

EPA funded nine basic research projects at a cost of about $590,000, all of which were completed as of April 1973. These projects generally were for studies and investigations of the composition and causes of water pollution resulting from acid drainage. EPA estimated that additional costs of $300,000 to $400,000 would be required for future basic research studies emphasizing pollution associated with mining for minerals other than coal.

TREATMENT

EPA's most significant acid drainage research and development effort was directed toward developing treatment techniques to eliminate or reduce the effects of acid drainage. EPA funded 33 extramural treatment projects at a cost of about $3.5 million. As of April 1973, 26 projects had been completed.

The following table shows EPA's projects for treating acid drainage, the Federal funding, and EPA's opinion of the results of these projects.

Technique	Projects	EPA's opinion of results	Federal funding
Lime/limestone neutralization	7	Successful	$1,464,000
Reverse osmosis and neutrolosis	4	Promising	368,000
Ion exchange	2	Promising	159,000
Pretreatment:			
Electrochemical	2	Promising	171,000
Ozone	2	Unsuccessful	36,000
Carbon	1	Unsuccessful	50,000
Sludge treatment	4	Promising	219,000
Other:			
Biological	3	Unsuccessful	210,000
Freezing process	1	Unsuccessful	10,000
Foam separation	2	Unsuccessful	137,000
Sulfide/sulfate	5	Unsuccessful	724,000
Total	33		$3,548,000

In addition to this extramural effort, EPA had conducted in-house research related to treatment at a cost of about $1.1 million. Primary emphasis of this research was on the neutralization and reverse osmosis techniques.

EPA estimated that 70 percent of the technology required to adequately treat acid drainage had been developed and that it would cost from $2 to $3 million to develop the additional technology required. An EPA official stated that future efforts in this area would be directed toward further development of promising techniques. The official stated that EPA did not plan to fund additional projects to develop new treatment techniques unless a technique with significant potential became available.

Lime/Limestone neutralization

Most acid drainage treatment plants used during active mining operations add lime or limestone to the drainage to neutralize the acidity. Neutralization can produce water acceptable for discharge into streams but unacceptable for municipal or industrial uses without further treatment. The following photograph shows a typical lime neutralization plant. In this operation, lime is added to acidic water before the water is channeled into a storage area where it is mixed and aerated.

[Photograph not included in this copy of the report.]

(EPA Photograph)

LIME NEUTRALIZATION TREATMENT PLANT
USED TO TREAT ACID WATER

EPA officials consider that their lime/limestone treatment efforts are the most successful of all treatment research and have wide applicability to the acid drainage problem. The seven lime/limestone projects, three of which are completed, involved the design, construction, and operation of lime/limestone treatment plants; determinations of the best type of lime/limestone to treat various concentrations of mine drainage; a process to produce potable water from neutralized mine drainage; and the use of limestone barriers in streams. The following photograph shows a limestone barrier constructed in a stream to eliminate mine drainage pollution by neutralization.

[Photograph not included in this copy of the report.]

(EPA Photograph)

LIMESTONE BARRIER USED TO NEUTRALIZE ACID DRAINAGE IN A STREAM

EPA estimated that the lime/limestone technique removes 95 to 99 percent of acidity and that the cost of water treated ranges from $0.03 to $1.20 per thousand gallons, depending on

the acidity of the water and the size of the treatment plant. An EPA official estimated that an additional $300,000 would be required to fully develop this technique by optimizing the use of lime and limestone to lower the cost and reduce byproduct disposal problems.

Reverse osmosis and neutrolosis

In reverse osmosis, polluted water is forced against a membrane under high pressure causing unpolluted water to pass through. This process can produce high-quality water suitable for municipalities and industries with little additional treatment. Reverse osmosis was initially developed by Interior's Office of Saline Water as part of its program to produce potable water from saline water. EPA considers reverse osmosis promising for treating acid drainage and estimates that 95 to 99 percent of the acid in the water can be removed by this process. Costs range from $0.70 to $1.50 per thousand gallons of water treated.

Reverse osmosis produces, as a waste product, a concentrated acid (brine) which must be treated before it can be discharged into a stream. Neutrolosis, a process being patented by EPA, is designed to solve this problem. By combining the favorable features of reverse osmosis and lime/limestone neutralization, neutrolosis produces high-quality water and an easily disposed-of waste product.

Three of the four reverse osmosis projects have been completed, and EPA estimates that 80 percent of the technology has been developed for this process.

EPA plans to spend an additional $300,000 to further develop the reverse osmosis and neutrolosis processes, primarily by developing a more efficient and durable membrane.

Ion exchange

In ion exchange, water pollutants are removed from acid drainage by being exchanged with another more desirable mineral in a treatment bed. The pollutants are retained in the treatment bed until they are removed to a waste water impoundment area. The new mineral in the treated water is either removed by further processing or permitted to remain if its concentration does not exceed acceptable levels.

EPA estimates that this process costs between $0.75 and $2 per thousand gallons of water treated and has an effectiveness range of 85- to 99-percent acid removal. Both projects involving this process have been completed. An EPA official stated that development of this technique, which is approximately 10 percent complete, has been delayed about 1 year because of funding constraints. EPA plans to spend an additional $1 million to further develop this technique, emphasizing larger scale testing to prove its validity.

Pretreatment techniques

Pretreatment techniques prepare polluted mine water for lime/limestone, reverse osmosis, or ion exchange treatment. EPA has funded five projects involving three pretreatment techniques--electrochemical, ozone, and carbon.

EPA officials considered the electrochemical process, which applies an electrical charge to the polluted water, to be the most promising. This pretreatment technique is estimated to cost from 2 cents to 10 cents per thousand gallons of water treated. One of the two electrochemical projects has been completed. EPA officials plan to spend an additional $100,000 to further develop this technique to make it more compatible with treatment processes. They told us that development of this technique had been delayed by agency funding constraints.

An EPA official stated the ozone and carbon techniques were effective as pretreatment processes but were too costly for widespread use. The ozone technique uses ozone gas and is estimated by EPA to cost from 10 cents to 80 cents per thousand gallons of water treated. The carbon technique uses activated carbon and is estimated to cost from $62 to $165 per thousand gallons of water treated. Both these techniques exceed the estimated cost parameters of electrochemical pretreatment, and we were informed that EPA did not plan to spend additional funds on further developing them.

Sludge treatment techniques

Most acid drainage treatment processes produce a waste product called sludge which causes significant handling and disposal problems. EPA funded four projects for various methods to handle and dispose of sludge. These projects have been completed, and EPA considers their results promising.

EPA officials estimated the cost of techniques to handle and dispose of sludge at $0.10 to $2 per thousand gallons of water treated, depending on the technique used. EPA officials estimated that an additional $250,000 was needed to develop sludge treatment techniques and stated that this research has been delayed about 1 year due to EPA funding constraints. EPA plans to concentrate on drying methods and techniques to use sludge for irrigation.

Other treatment techniques

EPA considered other treatment techniques--biological, freezing, foam separation, and sulfide/sulfate--unsuccessful because they were either technically or economically infeasible. All project techniques had been completed as of April 1973. EPA plans no additional work using these techniques unless a significant scientific breakthrough develops.

Conclusions

We engaged a consultant to assist us in evaluating EPA's program to develop acid drainage treatment technology. On the basis of our review and our consultant's evaluation, we believe that EPA's treatment program has produced techniques which (1) have been demonstrated to be effective in treating acid drainage or (2) show promise of being effective but require additional research. EPA's estimate that about 70 percent of the technology has been developed to adequately treat acid drainage from mines appears reasonable. EPA's decisions on the areas warranting additional research and the related funds required also appear reasonable.

We believe that EPA's April 1972 plan, which provided for developing the required treatment technology by 1978, is reasonable on the basis of the amount of work completed, the present level of effort, and the projects scheduled for future funding. The individual treatment projects, if adequately funded, appear to be progressing so as to allow EPA to meet the 1978 date.

PREVENTION OF ACID DRAINAGE FROM UNDERGROUND MINES

EPA officials stated that the most critical need for technological development is for techniques or processes to prevent acid drainage from underground mines, especially abandoned ones.

EPA funded 13 projects related to underground mining at a cost of about $1.8 million. Non-Federal funding totaled about $500,000. As of April 1973, 9 of the 13 projects were complete. The following table shows the techniques used, EPA's opinion of the results of these projects, and the Federal funding.

Technique	Projects	EPA's opinion of results	Federal funding
Bulkhead seals	4	Successful	$ 873,000
Inert gas	3	Promising	157,000
Internal sealing	3	Promising	428,000
Other:			
Latex soil sealant	1	Unsuccessful	182,000
Underground mine detection	1	Unsuccessful	115,000
Underground mining methods	1	Unsuccessful	83,000
Total	13		$1,838,000

EPA estimated that it had developed about 10 percent of the technology required to prevent acid drainage from underground mines and that an additional $20 to $30 million for research was needed to further refine promising techniques.

Bulkhead seals

Bulkhead seals, constructed with concrete, limestone, or other material, are used to block mine entrances or inner tunnels of abandoned mines. These seals are designed to prevent oxygen from entering the mine and to retain drainage behind the seal.

An EPA official stated that these seals had been the most successful underground acid drainage prevention technique developed and that under certain conditions a mine can be effectively sealed by this technique. Some types of bulkhead seals are being used commercially and are considered by EPA officials to be 75 percent to 99 percent effective in reducing acid pollution when properly implemented. The cost of these seals ranges from $1,000 to $20,000 per seal.

EPA does not plan to further develop bulkhead seal technology, except for a self-sealing plug which is placed in the mine opening. As the acid drainage flows through, it is neutralized and a residue is formed which seals the opening. This type of plug has been successfully used in laboratory studies and has been tested on a limited basis in mines. An EPA official stated that the limestone plug, when developed, could be less expensive than other bulkhead seals. EPA plans to spend an additional $200,000 on this technique starting in fiscal year 1973.

Inert gas

Another underground mining technique, which is being developed to control water pollution from abandoned mines and which is considered promising by EPA, is the use of inert gas to replace oxygen and thereby prevent the formation of acid. EPA indicated that laboratory studies have shown the feasibility of this technique. However, major problems still exist in preventing the escape of the gas. EPA estimated that an additional $800,000 would be spent beginning in fiscal year 1975 to test this technique at an abandoned underground mine.

Internal sealing

EPA stated that internal sealing--the injection of a chemical into a mine to prevent acid formation--was another promising underground control technique which was not fully developed. One promising internal sealing method uses a lime/limestone mixture which is injected into a mine to seal small cracks where leakage is occurring. As acid flows through this mixture, it is treated and forms a sludge which seals the leak. An EPA official stated that this process can stop leaks in bulkhead seals.

Styrofoam sealing, another internal sealing method, involves filling a section of a mine with foam which covers the sulfur-bearing materials and thus prevents acid formation.

No cost parameters or degrees of effectiveness were available for these internal sealing methods because of their early stages of development. EPA estimated that an additional $500,000 would be required to further develop these techniques. An EPA official told us that, because of agency funding constraints, further development of internal sealing methods was not expected until fiscal year 1980.

Other underground mining techniques or studies

Some of the projects for preventing acid drainage from underground mines were considered unsuccessful because of technical problems and implementation costs. These included various underground mine detection efforts to identify acid pollution sources and the use of a latex soil sealant to divert surface water from underground mines. EPA plans no further work on these techniques since they were not considered successful or promising.

EPA funded one project to review various methods available to abate water pollution from underground mines. The grantee reviewed the state of the art for underground mining. EPA officials told us that the grantee also was supposed to develop new methods for acid drainage prevention from underground mining but was unable to do so. They stated that a need still exists for new and innovative technology for preventing and controlling drainage from underground mines. The officials stated that, in fiscal year 1974, they plan to request proposals for the development of such technology.

PREVENTION OF ACID DRAINAGE FROM SURFACE SOURCES

EPA projects to prevent acid drainage from surface sources (mines, spoil, refuse piles, slurry areas) included backfilling, regrading, contouring, revegetating, and building water impoundment areas. These methods, while preventing drainage, also helped to control other mine-related problems, such as erosion and siltation, and were implemented primarily as reclamation measures.

EPA estimated that reclamation techniques for preventing acid drainage from surface sources are from 75 to 95 percent effective and cost from $300 to $3,000 an acre. These estimates depend on the type of surface area, slope of land, and proposed use of the land.

As a part of the reclamation process, revegetation is used to establish a cover on surface-mined areas. EPA estimated that revegetation, which costs from $70 to $700 an acre, is 60 to 95 percent effective in controlling acid drainage. The cost and effectiveness of revegetation depends on the type and thickness of surface cover and soil conditions.

EPA funded eight projects, at a cost of about $1.2 million, related to preventing acid drainage from surface sources. Non-Federal costs totaled about $1 million. Five of these projects had been completed as of April 1973. EPA considers the technology developed to date for preventing acid drainage from surface sources as promising. EPA officials stated that about 50 percent of the technology required to prevent acid formation in surface sources has been developed but that EPA funding constraints have delayed the program and an additional $4 million to $6 million for research is still needed.

Mine spoil

EPA funded two mine spoil projects at a cost of about $256,000. The projects were directed toward preplanning mining operations to avoid acid drainage discharge into waterways. One of the projects, which has been completed, consisted of a study to analyze spoil for potential acid, sediment, and other pollutants. EPA considered the results

of the study promising and funded a second project to include additional geographical areas to determine whether the methods developed applied to other types of spoil.

An EPA official told us that, as a result of EPA's work on spoil, three States--Ohio, Montana, and West Virginia--require preplanning of surface mines and analysis of spoil before mine operations can be approved. EPA plans to fund additional mine spoil work with primary emphasis on drainage problems other than acid.

Refuse piles

Coal refuse piles contain sulfur-bearing materials which become exposed to air and water and form acid that drains into waterways.

EPA funded three projects at a cost of about $559,000 for research on the stabilization of refuse piles. Two completed projects showed that certain chemical sealants can be used to prevent acid formation from refuse piles. The third project, which was active, used a soil cover to stabilize a coal refuse pile. The following photographs from this project show the acid-producing refuse pile before and after being covered by soil and seeded. An EPA official said acid from this pile has been reduced significantly.

[Photograph not included in this copy of the report.]

(EPA Photograph)

COAL REFUSE PILE BEFORE RECLAMATION

[Photograph not included in this copy of the report.]

COAL REFUSE PILE AFTER RECLAMATION (EPA Photograph)

An EPA official stated that this project was being conducted primarily to determine the depth of the soil cover which must be placed on the refuse piles to control acid drainage under varying conditions.

EPA estimated that its reclamation efforts on refuse piles were from 50 to 90 percent effective in controlling acid drainage and cost from $2,000 to $10,000 an acre.

Slurry areas

The potential water pollution from slurry areas can be reduced by treating with chemicals, covering with soil, revegetating, or flooding the areas. EPA estimated that these methods were 25 to 95 percent effective in controlling acid drainage pollution and that they cost from $300 to $2,000 an acre, depending on the size and location of the slurry area. EPA funded one research project totaling about $21,000 which involved a study of the composition of waste water contained in a slurry area.

EPA plans additional research on developing techniques to stabilize slurry areas by using evaporation and chemical methods.

Other surface projects

EPA funded two other projects related to the prevention of acid drainage from surface sources. The objective of one of these projects was to monitor and evaluate the effectiveness of acid drainage prevention techniques by compiling data on stream flow and water quality.

PREVENTION OF ACID DRAINAGE BY NEW MINING METHODS

EPA's research on new mining methods involved developing alternative methods to mine both surface and underground coal and emphasized reducing acid drainage from mining operations.

EPA funded three such projects and estimated that their technologies were 10 percent developed. The following table shows the techniques being developed and EPA's opinion of their potential.

Technique	Projects	EPA's opinion of results	Federal funding
Oxygen-free mining	2	Promising	$652,000
Longwall stripping	1	Promising	88,000
Total	3		$740,000

An EPA official stated that EPA was unable to develop other new mining methods because of agency funding constraints and that it needed $36 to $50 million more.

Oxygen-free mining

When coal is mined in an oxygen-free atmosphere using self-supporting life systems similar to space suits, an inert gas is substituted for oxygen in a sealed underground mine, thus eliminating the presence of one element necessary for acid formation. The following photograph shows the type of life-support equipment used by a miner in an EPA development project.

The initial project, which has been completed, was an engineering evaluation of the feasibility of using this technique with standard mining equipment. The second project, which was active as of April 1973, involves testing the life-support equipment under actual working conditions.

EPA and the Bureau of Mines disagreed as of April 1973 over safety features of this technique. According to EPA, oxygen-free mining is considered feasible and promising. EPA informed us that this technique would not only prevent acid

[Photograph not included in this copy of the report]

(EPA Photograph)

EQUIPMENT USED BY A MINER IN AN OXYGEN-FREE MINING EXPERIMENT

drainage but would also protect the miners from black lung disease. The Bureau of Mines, which funded about $15,000 of the research on this technique, stated that it would not participate in future studies because this type of mining would place a miner in a more hostile environment; he could not breathe in the mine atmosphere in case of equipment failure.

EPA told us that developing the oxygen-free mining technique would require $2 million to $3 million of Federal funding but that, because of agency funding constraints within EPA, further development of this technique was not planned until after fiscal year 1974.

Longwall stripping

Longwall stripping, a mining technique being evaluated by EPA, is an adaptation of longwall mining, a proven underground mining method commercially used in several European countries. Longwall mining uses mining equipment to support the mine roof while coal is mechanically removed. After the coal and the equipment are removed, the roof of the mine collapses, preventing the exposure of sulfur-bearing material to oxygen and water, thus preventing acid formation. By applying this technique to mining situations, EPA believes that the environmental destruction caused by strip mining can be avoided and that acid formation can be prevented.

EPA considers longwall stripping a promising and feasible mining technique applicable to almost all strip mining in Appalachia. EPA plans to spend from $200,000 to $300,000 in fiscal year 1974 on this technique in cooperation with private industry, which will provide an additional $600,000 to $800,000.

DEMONSTRATION PROGRAM

The Federal Water Pollution Control Act, as amended, authorizes EPA to implement a program to demonstrate comprehensive approaches toward eliminating or controlling acid or other mine-water pollution resulting from active or abandoned mining operations. This program is to demonstrate the practicality and the engineering and economic feasibility of various methods for eliminating or controlling mine drainage pollution. The act, as amended, authorized $30 million to be appropriated for this program.

EPA's efforts in this area began in 1971 and, as of April 1973, seven grants totaling about $3.5 million had been awarded to five Appalachian States to conduct demonstration projects in seven small river basins. Expenditures for this program have not been greater because of EPA funding constraints.

Each grantee is to identify mine-drainage pollution sources in the basin area, select the equipment and method to be applied to each, construct a treatment plant or implement the techniques selected, and monitor the results. The technology to be used consists of techniques developed

primarily through EPA research and development projects involving treatment of acid mine drainage and prevention of underground and surface drainage from mining sources. As of April 1973 EPA was conducting feasibility studies for some of the seven projects and the others were in the early construction stage.

EPA also funded three projects totaling about $130,000 to (1) develop a manual to assist States in submitting proposals to EPA for demonstration projects, (2) perform a model feasibility study of a small river basin area, and (3) use a computer in allocating resources to reclaim a small basin area. As of April 1973 the first two projects had been completed.

EPA estimated that an additional $29 million to $40 million would be needed to fund a continuing demonstration program related to the treatment and prevention of acid mine drainage.

CHAPTER 4

OTHER FEDERALLY ASSISTED ACID DRAINAGE PROJECTS

During fiscal years 1967 through 1972, Interior and Agriculture, the Corps of Engineers, and the Appalachian Regional Commission funded 25 projects, totaling about $4.3 million, related to water pollution caused primarily by acid drainage from mines. In fiscal year 1973, 13 of these projects were active.

Generally, the objectives of these projects were to

--study the type and extent of water pollution caused by acid drainage and

--develop and demonstrate new or improved technology to control pollution caused by acid drainage.

The scope of these projects was generally limited and was not oriented toward an overall planned effort to solve and control water pollution caused by acid drainage. Most of the projects were funded to help solve specific localized water pollution problems or to protect natural resources. An EPA official indicated that the agency was aware of the majority of the acid drainage projects funded by other Federal agencies; used some of the project results as a basis for, or in support of, its research and development efforts; and participated in some of the projects which complemented its research and development program.

DEPARTMENT OF THE INTERIOR

The Bureau of Mines conducts research on environmental problems associated with mineral wastes and funds projects concerning environmental problems of the mineral industries. During the past 6 fiscal years the Bureau funded three acid drainage projects totaling about $520,000 which had been completed by fiscal year 1972. The projects were directed toward (1) developing techniques in mine sealing and mine drainage control from active mines and (2) studying the chemistry of mine water.

In April 1972 the Bureau discontinued its research and development efforts related to acid drainage because of increasing requirements in mine health and safety and because

of a shortage of funds. We were informed that the Bureau plans no future projects related to acid drainage.

The Office of Saline Water conducts research on the economical conversion of saline water (which may consist of chemically charged and mineralized water) for beneficial uses. The Office's primary concern is to provide potable water to the water user, both municipal and industrial, rather than to eliminate water pollution.

The Office of Saline Water funded six research and development projects related to acid drainage--four of which have been completed--totaling about $410,000. These projects were directed toward developing techniques to produce potable water from water polluted by acid drainage. Officials of the Office informed us that the treatment techniques being developed would apply more to providing high-quality water to users rather than to cleaning up streams or rivers.

The Office of Water Resources Research develops new technology and more efficient methods for solving water resource problems. The Office funded two projects related to acid drainage, totaling about $31,000. The one completed project was directed toward determining the possibility of treating both municipal sewage and acid drainage by combining the two waste discharges so that the pollutants in each would be neutralized. The active project is directed toward treating acid by biological methods.

DEPARTMENT OF AGRICULTURE

Within Agriculture, the Agricultural Research Service, the Cooperative State Research Service, and the Forest Service were conducting four projects related to acid drainage totaling about $1,980,000.

Two projects were to demonstrate the potential for growing plants in waste material produced during mining operations; one project was to demonstrate ways to reduce surface-mining damage to forest resources; and one project was to eliminate a water quality problem caused by acid drainage on a tract of Government-owned land.

CORPS OF ENGINEERS

The Corps of Engineers funded three projects at a cost of about $470,000, one of which has been completed. The objective of the two active projects is to study acid drainage in the Susquehanna River Basin and the effects of strip mining on navigable waters. The objective of the completed project was to study the incidence and formation of acid drainage pollution in Appalachia.

APPALACHIAN REGIONAL COMMISSION

The Appalachian Regional Commission, a joint Federal-State partnership concerned with the economic and social development of the 13-State Appalachian region, funded 7 projects relating to acid drainage. As of April 1973 three of the projects had been completed. The objectives of the seven projects ranged from determining the effects of acid drainage and developing acid drainage treatment techniques to taking acid drainage source inventories and developing improved surface-mining techniques. The costs of the seven projects totaled approximately $890,000.

The most significant project conducted by the Commission was its $590,000 study of acid drainage from mines in Appalachia. The project addressed the technical and environmental implications of the acid drainage problem and its economic impact on the Appalachian region. The report submitted to the President on June 30, 1969, contained recommendations for initiating a comprehensive plan to control and abate acid drainage in the Appalachian region, including

--continued reseach to develop technology to more economically and effectively solve the problem and

--an action program for controlling and abating acid drainage as part of a comprehensive pollution control and environmental improvement program.

APPENDIX I

NINETY-SECOND CONGRESS

Congress of the United States

House of Representatives

CONSERVATION AND NATURAL RESOURCES SUBCOMMITTEE
OF THE
COMMITTEE ON GOVERNMENT OPERATIONS
RAYBURN HOUSE OFFICE BUILDING, ROOM
WASHINGTON, D.C.

August 21, 1972

Mr. Elmer B. Staats
United States Comptroller General
General Accounting Office
Washington, D. C. 20548

Dear Mr. Staats:

Section 14 of the Federal Water Pollution Control Act, as amended, authorizes the Administrator of the Environmental Protection Agency to carry out a program of area acid and other mine water pollution control. We understand that EPA also conducts a research effort in this area under other provisions of that Act.

In addition, the Interior Department, through the Bureau of Mines and the Office of Coal Research, has and is conducting a research and demonstration program in this area under other provisions of law.

We are concerned whether both agencies are carrying out these dual programs economically and efficiently and, in particular, are taking effective means to avoid duplication of effort. We are also concerned that, while these programs have been underway at both agencies for some time, they apparently have not achieved results that could lead to an effective acid and other mine water control program.

It would be most helpful to the Subcommittee if the GAO would investigate the administration of these programs, including the policies and procedures applied by each agency in carrying them out. Your investigation should also include a review of the contract and grant procedures of the agencies in regard to these programs and of the actual contracts and grants themselves, particularly those carried out by mineral industry or related industries. A review of past and present demonstration projects should also be included.

We request that the GAO provide to us a report of your findings and recommendations. During the course of your investigation and before finalizing your report, we would appreciate it if your staff would discuss your proposed findings with our Subcommittee staff.

Sincerely,

Henry S. Reuss

HENRY S. REUSS, Chairman
Conservation and Natural Resources
Subcommittee

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APPENDIX II

EPA ACID DRAINAGE PROJECTS--FISCAL YEARS

1967-72

BASIC RESEARCH:

1. Title: A Pilot-Scale Study of Acid Mine Drainage
   Award date: June 30, 1967
   Status: Completed
   Contractor: Ohio State University Research Foundation
   Cost: Total, $79,301; Federal, $79,301

2. Title: Acid Mine Drainage--An Analysis of the State of the Art
   Award date: November 28, 1967
   Status: Completed
   Grantee: Ohio State University Research Foundation
   Cost: Total, $28,811; Federal, $28,811

3. Title: Study of Sulfide to Sulfate Reaction Mechanism
   Award date: May 20, 1968
   Status: Completed
   Grantee: Ohio State University Resarch Foundation
   Cost: Total, $152,763; Federal, $151,402

4. Title: Inorganic Sulfur Oxidation by Iron-Oxidizing Bacteria
   Award date: August 7, 1968
   Status: Completed
   Grantee: Syracuse University Research Institute
   Cost: Total, $117,575; Federal, $98,450

5. Title: Acid Mine Drainage--Pilot Plant Evaluation
   Award date: January 8, 1969
   Status: Completed
   Grantee: Carnegie-Mellon University
   Cost: Total, $63,910; Federal, $57,518

6. Title: Microbial Mediation in Generation of Acid Mines Wastes
   Award date: June 10, 1969
   Status: Completed
   Grantee: President and fellows of Harvard College
   Cost: Total, $27,018; Federal, $25,667

7. Title: Pyritic Systems: A Mathematical Model
   Award date: October 29, 1969
   Status: Completed
   Contractor: Ohio State University Research Foundation
   Cost: Total, $68,918; Federal, $68,918

8. Title: Evaluation of Pyritic Oxidation by Nuclear Methods
   Award date: March 4, 1970
   Status: Completed
   Grantee: Carnegie-Mellon University
   Cost: Total, $39,635; Federal, $35,672

9. Title: An Analysis of the Legal Problems in Reclamation of Mines in Appalachia
   Award date: June 29, 1970
   Status Completed
   Grantee: University of Maryland School of Law
   Cost: Total, $44,523; Federal $42,247

TREATMENT:

10. Title: Microbiological Removal of Iron from Mine Drainage Waters
    Award date: September 1, 1967
    Status: Completed
    Grantee: Continental Oil Company
    Cost: Total, $115,996; Federal, $75,886

11. Title: Optimization and Development of Improved Chemical Techniques for the Treatment of Coal Mine Drainage
    Award date: February 7, 1968
    Status: Completed
    Grantee: Commonwealth of Pennsylvania
    Cost: Total, $150,000; Federal, $105,000

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12. Title: Construction of Mine Water Treatment Plant at Hollywood, Pennsylvania
Award date: March 28, 1968
Status: Active
Grantee: Commonwealth of Pennsylvania
Cost: Total, $1,000,000; Federal, $700,000

13. Title: Application of Bacteriophages to Eliminate Mine Acids
Award date: June 6, 1968
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $123,723; Federal, $86,484

14. Title: Biological Treatment of Acid Mine Water
Award date: June 11, 1968
Status: Completed
Grantee: Syracuse University Research Institute
Cost: Total, $54,341; Federal $47,238

15. Title: Feasibility of the Purification of Acid Mine Water by a Partial Freezing Process
Award date: July 17, 1968
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $15,000; Federal, $10,500

16. Title: Sulfide Treatment of Acid Mine Drainage
Award date: August 12, 1968
Status: Completed
Grantee: Bituminous Coal Research, Inc.
Cost: Total, $77,690; Federal, $54,380

17. Title: Lime/Limestone Neutralization of Acid Mine Drainage
Award date: November 6, 1968
Status: Active
Grantee: Peabody Coal Company
Cost: Total, $692,000; Federal, $472,400

18. Title: Design for Acid Mine Drainage Treatment Plant at Norton, W. Va.
Award date: November 19, 1968
Status: Completed
Contractor: Ruble and Kaple, Inc.
Cost: Total, $4,708; Federal, $4,708

19. Title: Abatement of Acid Mine Drainage Pollution by Reverse Osmosis
Award date: February 13, 1969
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total $39,426; Federal, $27,598

20. Title: Treatment of Acid Mine Drainage
Award date: February 28, 1969
Status: Completed
Contractor: Horizons, Inc.
Cost: Total, $49,300; Federal, $49,300

21. Title: Treatment of Acid Mine Drainage
Award date: April 7, 1969
Status: Completed
Contractor: Catalytic Construction Company
Cost: Total, $327,629; Federal, $327,629

22. Title: Acid Mine Waste Treatment Utilizing a Reverse Osmosis Pilot Plant
Award date: April 7, 1969
Status: Completed
Contractor: Gulf General Atomic, Inc.
Cost: Total, $106,500; Federal, $106,500

23. Title: Treatment of Acid Mine Drainage--Sulfur and Iron Recovery
Award date: April 18, 1969
Status: Completed
Contractor: Black, Sivalls, & Bryson, Inc.
Cost: Total, $233,702; Federal, $233,702

24. Title: Development and Optimization of the Limestone Treatment of Coal Mine Drainage
Award date: June 25, 1969
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $106,480; Federal $74,536

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25. Title: Neutralization and Precoat Filtration of Concentrated Sludges from Mine Water
Award date: September 11, 1969
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $100,770; Federal, $70,539

26. Title: Recovery of Iron in a More Dense Form From Coal Mine Drainage
Award date: September 26, 1969
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $81,695; Federal, $57,186

27. Title: The Thickening and Dewatering of Precipitates from the Lime/Limestone Treatment of Mine Drainage
Award date: February 5, 1970
Status: Completed
Grantee: West Virginia University
Cost: Total, $99,938; Federal, $69,957

28. Title: Treatment of Acid Mine Drainage by Ozone Oxidation
Award date: March 13, 1970
Status: Completed
Contractor: U.S. Atomic Energy Commission
Cost: Total, $20,000; Federal, $20,000

29. Title: Electrochemical Treatment of Acid Mine Waters
Award date: April 21, 1970
Status: Completed
Contractor: Corporate Research Division, Tyco Laboratories, Inc.
Cost: Total, $81,160; Federal, $81,160

30. Title: Abatement of Acid Mine Drainage Pollution by Reverse Osmosis
Award date: June 3, 1970
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $69,630; Federal, $48,741

31. Title: Treatment of Acid Mine Drainage
Award date: June 12, 1970
Status: Completed
Contractor: Horizons, Inc.
Cost: Total, $88,008; Federal, $88,008

32. Title: Evaluation of Lime-Soda Ash Treatment of Neutralized Mine Drainage
Award date: June 18, 1970
Status: Active
Grantee: Commonwealth of Pennsylvania
Cost: Total, $2,598,340; Federal, $78,930

33. Title: Study of the Conversion of Pyrites by Oxidation in Chlorinated Solvents
Award date: June 21, 1970
Status: Completed
Contractor: Cyrus Wm. Rice Division NUS Corporation
Cost: Total, $73,810; Federal, $73,810

34. Title: Trough Creek Limestone Barrier Installation and Evaluation
Award date: June 22, 1970
Status: Active
Grantee: Commonwealth of Pennsylvania
Cost: Total, $224,660; Federal, $28,160

35. Title: The Effect of Soluble Iron Upon Municipal Waste Treatment Facilities
Award date: June 24, 1970
Status: Completed
Contractor: Resources Engineering Association, Environmental Research and Application, Inc.
Cost: Total, $21,745; Federal, $21,745

36. Title: Acid Mine Drainage Treatment by Ion Exchange
Award date: June 29, 1970
Status: Completed
Contractor: Culligan Incorporated
Cost: Total, $88,483; Federal, $88,483

APPENDIX II

37. Title: Study of Sulfur Recovery from Coal Mine Refuse as a Profitable Means of Eliminating Acid Water Drainage from Coal Refuse Piles
Award date: September 15, 1970
Status: Completed
Contractor: Black, Sivalls, & Bryson, Inc.
Cost: Total, $34,000; Federal, $34,000

38. Title: Conversion of Mine Drainage to Potable Water by Sulfate Cycle Ion Exchange
Award date: February 25, 1971
Status: Completed
Contractor: Aqua-Ion Corporation
Cost: Total, $70,265; Federal, $70,265

39. Title: Studies on the Removal of Manganese from Mine Drainage
Award date: May 7, 1971
Status: Active
Grantee: Wilkes College
Cost: Total, $17,357; Federal, $16,489

40. Title: Oxidation of Ferrous Iron in Coal Mine Water with Activated Carbon Catalysts
Award date: May 18, 1971
Status: Completed
Grantee: Bituminous Coal Research, Inc.
Cost: Total, $71,140; Federal, $49,800

41. Title: Pilot Plant Purification of Acid Mine Drainage by Reverse Osmosis
Award date: June 25, 1971
Status: Active
Contractor: West Virginia University
Cost: Total, $185,619; Federal, $185,619

42. Title: Electrochemical Removal of Heavy Metals from Acid Mine Drainage
Award date: June 3, 1971
Status: Active
Grantee: Commonwealth of Pennsylvania
Cost: Total, $127,786; Federal, $89,457

PREVENTION--UNDERGROUND MINES:

43. Title: Study of the Use of Inert Gas to Eliminate Acid Pollution From Abandoned Deep Mines
Award date: June 6, 1968
Status: Active
Grantee: Commonwealth of Pennsylvania
Cost: Total, $172,027; Federal, $83,784

44. Title: The Use of Inert Gases to Eliminate Pollution From Abandoned Mines
Award date: June 17, 1968
Status: Completed
Contractor: Cyrus Wm. Rice Division
NUS Corporation
Cost: Total, $19,689; Federal, $19,689

45. Title: Study of the Use of Internal Precipitation of Sludge Resulting From Reaction of Mine Water with Low Cost Additives in an Abandoned Mine to Prevent Mine Drainage Pollution
Award date: June 25, 1968
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $325,035; Federal, $227,524

46. Title: Use of Latex as a Soil Sealant to Control Acid Mine Waste Drainage
Award date: June 26, 1968
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $259,770; Federal, $181,839

47. Title: Research, Development and Field Testing of Mine Water Pollution Abatement Methods
Award date: July 15, 1968
Status: Completed
Contractor: Halliburton Company
Cost: Total, $328,830; Federal, $328,830

APPENDIX II

48. Title: Evaluation of Pollution Abatement Procedures in the Moraine State Park, Butler County, Pa.
Award date: July 17, 1968
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $21,600; Federal, $15,120

49. Title: Catawisa Creek Mine Drainage Pollution Abatement Project
Award date: July 17, 1968
Status: Active
Grantee: Commonwealth of Pennsylvania
Cost: Total, $522,200; Federal, $365,540

50. Title: Detection & Location of Concealed Abandoned Underground Mines & Associated Drainage by Geochemical Techniques
Award date: June 20, 1969
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $164,780; Federal, $115,346

51. Title: Use of Gel Material for Sealing Deep Mine Openings
Award date: September 19, 1969
Status: Completed
Grantee: Commonwealth of Pennsylvania
Cost: Total, $205,000; Federal, $143,500

52. Title: Mining Operations for the Reduction of Harmful Drainage from Underground Coal Mines
Award date: March 4, 1970
Status: Completed
Grantee: West Virginia University
Cost: Total, $87,543; Federal, $83,166

53. Title: Continuation of the Laboratory Investigations of the Effects of Various Gas Atmospheres on the Oxidation of Coal Mine Pyrites
Award date: June 2, 1970
Status: Completed
Contractor: Cyrus Wm. Rice Division NUS Corporation
Cost: Total, $53,601; Federal, $53,601

54. Title: Acid Mine Drainage Seal Research
Award date: June 30, 1971
Status: Active
Contractor: NUS Corporation--D'Appolonia (joint venture)
Cost: Total, $162,976; Federal, $162,976

55. Title: High Expansion Foams as a Method of Inerting Abandoned Coal Mine Areas
Award date: June 29, 1972
Status: Active
Contractor: Mine Safety Appliance Company, MSA Research Corporation
Cost: Total, $56,870; Federal, $56,870

PREVENTION--SURFACE MINES:

56. Title: Technical Feasibility and Analysis of Costs and Effectiveness of Bulk Transport of Sewage Treatment Plant Sludge and Dredging Spoils
Award date: April 10, 1968
Status: Completed
Contractor: Bechtel Corporation
Cost: Total $279,597; Federal, $279,597

57. Title: Demonstration of Control of Acid Drainage from Coal Mine Refuse Piles and Slurry Areas
Award date: October 31, 1968
Status: Active
Grantee: Truax-Traer Coal Company
Cost: Total, $720,800; Federal, $490,560

APPENDIX II

58. Title: Silicate Treatment of Acid Mine Wastes
Award date: June 24, 1969
Status: Completed
Contractor: Corporate Research Division, Tyco Laboratories, Inc.
Cost: Total, $55,412; Federal, $55,412

59. Title: Mine Spoil Potentials for Water Quality and Controlled Erosion
Award date: June 30, 1969
Status: Completed
Grantee: West Virginia University
Cost: Total, $224,028; Federal, $156,328

60. Title: Flocculation & Clarification of Mineral Suspensions
Award date: March 6, 1970
Status: Completed
Grantee: University of Minnesota
Cost: Total, $23,723; Federal, $20,782

61. Title: Coal Refuse Binder
Award date: March 19, 1970
Status: Completed
Grantee: Black, Sivalls, & Bryson, Inc.
Cost: Total, $18,894; Federal, $13,226

62. Title: Evaluation of Miller's Run and Campbell's Run Mine Drainage Pollution Abatement
Award date: November 6, 1970
Status: Active
Grantee: Commonwealth of Pennsylvania
Cost: Total, $615,317; Federal, $49,748

63. Title: Mine Spoil Potentials for Soil and Water Quality
Award date: July 1, 1971
Status: Active
Grantee: West Virginia University
Cost: Total, $215,878; Federal, $99,903

PREVENTION--NEW MINING METHODS:

64. Title: A Demonstration of a New Mining Technique to Prevent the Formation of Mine Acid in an Active Deep Mine
Award date: August 1, 1969
Status: Completed
Grantee: Island Creek Coal Company
Cost: Total, $100,255; Federal, $70,178

65. Title: A Demonstration of a New Mining Technique to Prevent the Formation of Mine Acid in an Active Deep Mine
Award date: June 30, 1970
Status: Active
Grantee: Island Creek Coal Company
Cost: Total, $831,770; Federal, $582,239

66. Title: Feasibility Study of a New Surface Mining Method
Award date: August 18, 1972 (Funds from 1972 were used for this project.)
Status: Active
Contractor: Potomac Engineering & Surveying
Cost: Total, $88,021; Federal, $88,021

DEMONSTRATIONS:

67. Title: Feasibility Manual for Mine Drainage
Award date: March 4, 1970
Status: Completed
Contractor: Cyrus Wm. Rice Division, NUS Corporation
Cost: Total, $40,909; Federal, $40,909

68. Title: Feasibility Study--Sheban Impoundment & Reclamation Area
Award date: April 16, 1971
Status: Completed
Contractor: Stanley Consultants
Cost: Total $16,550; Federal, $16,550

APPENDIX II

69. Title: Demonstration of the Technique of Reuse of Treated Active Surface Mine Drainage for Revegetation Augmentation
Award date: June 16, 1971
Status: Active
Grantee: Commonwealth of Kentucky
Cost: Total, $460,098; Federal, $332,068

70. Title: Tioga River Mine Drainage Pollution Abatement Project
Award date: June 17, 1971
Status: Active
Grantee: Commonwealth of Pennsylvania
Cost: Total, $676,500; Federal, $450,000

71. Title: Demonstration of the Technique of Water Infiltration Control to Achieve Mine Water Pollution Control
Award date: June 22, 1971
Status: Active
Grantee: State of West Virginia
Cost: Total, $961,392; Federal, $672,000

72. Title: Lake Hope Mine Drainage Demonstration Project
Award date: June 25, 1971
Status: Active
Grantee: State of Ohio
Cost: Total, $1,320,131; Federal, $808,000

73. Title: Demonstration of Debris Basins for Control of Surface Mine Sedimentation in Steep Slope Terrain
Award date: June 27, 1972
Status: Active
Grantee: Commonwealth of Kentucky
Cost: Total, $327,551; Federal, $229,058

74. Title: Elk Creek Demonstration Project
Award date: June 28, 1972
Status: Active
Grantee: State of West Virginia
Cost: Total, $641,115; Federal, $448,700

75. Title: Resource Allocation to Optimize Mining Pollution Abatement Programs
Award date: June 29, 1972
Status: Active
Contractor: Ohio State University Research Foundation
Cost: Total, $70,423; Federal, $70,423

76. Title: Deer Park Daylighting Project
Award date: June 30, 1972
Status: Active
Grantee: State of Maryland
Cost: Total, $858,347; Federal, $550,000

APPENDIX III

OTHER FEDERALLY ASSISTED ACID DRAINAGE PROJECTS

FISCAL YEARS 1967-72

DEPARTMENT OF THE INTERIOR

Bureau of Mines:

1. Subject: Mine Sealing
   Initiated: Fiscal year 1964
   Status: Completed
   Grantee: None--in-house
   Cost: Total, $55,000 (fiscal years 1967-68); Federal, $55,000

2. Subject: Mine Drainage Control--Active Mines
   Initiated: Fiscal year 1966
   Status: Completed
   Grantee: None--in-house
   Cost: Total, $334,000 (fiscal years 1967-72); Federal, $334,000

3. Subject: Chemistry of Mine Waters--Neutralization
   Initiated: Early 1960s
   Status: Completed
   Grantee: None--in-house
   Cost: Total, $132,000 (fiscal years 1967-68); Federal, $132,000

Office of Saline Water:

4. Subject: Preliminary Evaluation of the Electrodialysis Process for Treatment of Acid Mine Drainage
   Initiated: June 1967
   Status: Completed
   Contractor: Ionics, Inc.
   Cost: Total, $18,703; Federal, $18,703

5. Subject: Field Testing of a Reverse Osmosis Unit on Acid Mine Waters
   Initiated: January 1968
   Status: Completed
   Contractor: Gulf General Atomic, Inc.
   Cost: Total, $46,837; Federal, $46,837

6. Subject: Further Field Testing of a Reverse Osmosis Unit on Acid Mine Drainage Waters
   Initiated: June 1968
   Status: Completed
   Contractor: Gulf General Atomic, Inc.
   Cost: Total, $37,770; Federal, $37,770

7. Subject: Reverse Osmosis Development for Acid Mine Drainage Conversion
   Initiated: May 1970
   Status: Completed
   Contractor: Zurn Environmental Engineers
   Cost: Total, $8,291; Federal, $8,291

8. Subject: Evaluation of Ion Exchange Process for Treatment of Mine Drainage Waters
   Initiated: June 1971
   Status: Active
   Grantee: Commonwealth of Pennsylvania
   Cost: Total, $279,713; Federal, $150,000

9. Subject: High Product Recovery Reverse Osmosis System for Conversion of Acid Mine Drainage
   Initiated: March 1972
   Status: Active
   Contractor: Rex Chainbelt, Inc.
   Cost: Total, $150,560; Federal, $150,560

Office of Water Resources Research:

10. Subject: The Biological Treatment of Coal Mine Drainage
    Initiated: July 1971
    Status: Active
    Grantee: Pennsylvania State University
    Cost: Total, $19,404; Federal, $19,404

11. Subject: Combination of Acid Mine Drainage and Sewage for Mutual Beneficiation
    Initiated: July 1971
    Status: Completed (Dec. 31, 1972)
    Grantee: Pennsylvania State University
    Cost: Total, $26,435; Federal, $12,041

APPENDIX III

DEPARTMENT OF AGRICULTURE

Agriculture Research Service:

12. Subject: Soil and Water Management System for Revegetation of Strip Mine Spoil Banks
    Initiated: Fiscal year 1969
    Status: Active
    Grantee: None--in-house
    Cost: Total, $422,000 (fiscal years 1969-72); Federal, $422,000

Cooperative State Research Service:

13. Subject: Mine Spoil Potentials for Plant Growth and Water Quality
    Initiated: June 1, 1969
    Status: Active
    Grantee: West Virginia University
    Cost: Total, $56,144 (fiscal years 1970-72); Federal, $56,144

Forest Service:

14. Subject: Palzo Restoration Project
    Initiated: Fiscal year 1971
    Status: Active
    Grantee: None--in-house
    Cost: Total, $126,500 (fiscal years 1971 and 1972); Federal, $126,500

15. Subject: Reduction in Surface-Mining Damages to Forest Resources by Improving Mining Procedures and Rehabilitation Measures --Berea, Kentucky
    Inititated: Fiscal year 1962
    Status: Active
    Grantee: None--in-house
    Cost: Total, $1,372,500 (fiscal years 1967-72); Federal, $1,372,500

CORPS OF ENGINEERS

16. Subject: Study of the Effects of Strip Mining Upon Navigable Waters and their Tributaries
    Initiated: Fiscal year 1972
    Status: Active
    Grantee: None--in-house
    Cost: Total, $100,000; Federal, $100,000

17. Subject: Susquehanna River Basin Mine Drainage Study
Initiated: Fiscal year 1970
Status: Active
Grantee: None--in-house
Cost: Total, $200,000 (fiscal years 1970-72); Federal, $200,000

18. Subject: Incidence and Formation of Mine Drainage Pollution in Appalachia
Initiated: Fiscal year 1965
Status: Completed
Grantee: None--in-house
Cost: Total, $172,500 (fiscal years 1967-69); Federal, $172,500

APPALACHIAN REGIONAL COMMISSION

19. Subject: Study of Acid Mine Drainage in Appalachia
Initiated: Fiscal year 1968
Status: Completed
Contractor: Various contractors
Cost: Total, $589,574; Federal, $589,574

20. Subject: Chemical Treatment of Mine Drainage
Initiated: Fiscal year 1968
Status: Completed
Contractor: Bituminous Coal Research, Inc. Monroeville, Pa.
Cost: Total, $67,000; Federal, $67,000

21. Subject: Aquatic Indicators--Effects of Acid Mine Drainage Pollution
Initiated: Fiscal year 1968
Status: Active
Grantee: Academy of Natural Sciences Philadelphia, Pa.
Cost: Total, $27,000; Federal, $27,000

22. Subject: Acid Mine Drainage Pilot Plant Evaluation
Initiated: Fiscal year 1968
Status: Completed
Grantee: Mellon Institute, Pittsburgh, Pa.
Cost: Total, $36,000; Federal, $36,000

APPENDIX III

23. Subject: Contract for the Research and Demonstration of Improved Surface Mining Techniques
Initiated: Fiscal year 1971
Status: Active
Grantee: State of Kentucky
Cost: Total, [a]$53,800; Federal, $40,350

24. Subject: Mine Drainage Source Inventory in the Casselman River/Cherry Creek River Basin of Maryland
Initiated: Fiscal year 1972
Status: Active
Grantee: State of Maryland
Cost: Total, $292,280; Federal, $88,000

25. Subject: Monongahela River Basin Study
Initiated: Fiscal year 1972
Status: Active
Contractor: Various contractors
Cost: Total, [b]$38,462; Federal, $38,462

[a]The total cost of this project is estimated to be approximately $437,500, of which $353,125 will be Federal cost. The total portion related to water quality problems is $53,800, of which $40,350 will be Federal cost.

[b]Contracts totaling approximately $500,000 are proposed. At the end of fiscal year 1972, two contracts totaling $156,000 had been awarded to study economic problems in the Monongahela River Basin area and two had been awarded totaling $38,462 to study technical problems related to acid mine drainage.

APPENDIX IV

CHRONOLOGY OF EPA AND ITS PREDECESSOR AGENCIES

WHICH HAD RESPONSIBILITY FOR THE

FEDERAL MINE DRAINAGE POLLUTION CONTROL PROGRAM

1967 The mine drainage program was established in the Federal Water Pollution Control Administration, Department of the Interior, as the Pollution Control Analysis Branch, Division of Engineering Development, Office of Research and Development.

1968 The Federal Water Pollution Control Administration was reorganized and the Pollution Control Analysis Branch was placed under the Division of Applied Science and Technology, Office of Research and Development.

1970 The Federal Water Pollution Control Administration became the Federal Water Quality Administration.

1970 The Federal Water Quality Administration was transferred to EPA. The mine drainage program was included under the Pollution Control Analysis Branch, Division of Applied Science and Technology, Office of Research and Monitoring.

1971 The mine drainage program was reorganized within EPA as the Pollution Control Analysis Section, Applied Science and Technology Branch, Technology Division, Office of Research and Monitoring.